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THE CHRONIC RHEUMATIC DISEASES

WITH SPECIAL REFERENCE TO CHRONIC ARTHRITIS

A SURVEY BASED ON 1,000 CASES

By ERNEST FLETCHER, M.A., M.D.,
M.R.C.P.

(Physician, Queen Mary's Hospital for the East End,
and The British Red Cross Clinic for Rheumatism,
and (with physical medicine) Royal Free Hospital.
Heberden Lecturer in Rheumatism)

AND

E. LEWIS-FANING, B.Sc.ECON., Ph.D.

(Of the Statistical Staff of the Medical Research
Council)

IN FOUR SECTIONS.

SECTION I

•Introduction

The bony changes which evolve in the course of chronic arthritis have played an important part in tracing its historical evolution. So far as ancient history is concerned, it therefore follows that osteoarthritis comes into the picture more frequently than infective arthritis. From such data it is known that the disease antedates man.

Chamberlain and Taft (1938) describe parts of the vertebral column of a mastodon found in South Carolina. The bones showed hypertrophic changes with bony bridging, and similar changes have been noted in the skeletons of prehistoric animals in the British Museum (Fisher, 1924). It is thought by geologists that the mastodon existed from the mid-miocene to the end of the pliocene (from ten million to one million years ago).

The earliest human case was probably that of the Neanderthal man of La Chapelle (40,000 B.C.). In this case the cervical spine (5-7) and the thoracic spine (1-3) were affected (Palés, 1930).

Glover (1928) mentions that chronic arthritis was as prevalent in the prehistoric dwellers of Nubia and Upper Egypt as amongst our Saxon forefathers of the Heptarchy. Hippocrates made observations on gout and joint disease in old age. In 1867 Charcot published his *Maladies des Vieillards*.

As Glover remarks, "the age-old history (of chronic arthritis) is a singularly barren one."

For the confusion in nomenclature, which will be mentioned later, was at its zenith in 1763, when Sauvage's *Nosologica Methodica* was published. He divided gout

(= arthritis) into fourteen forms, (one of which, arthritis rheumatica, appears to be what we now call infective arthritis), and rheumatism into ten forms. All these matters are presented in full form by Stockman (1920).

In the nineteenth century, exact clinical and pathological observation led to an increase of knowledge. In 1824 Benjamin Bell described eburnation of the femoral head, and Robert Smith (1847) described what we term osteoarthritis of the hips with accuracy. Some think he devised the term "malum coxae senilis" (1835), but Glover attributes it to Adams (1831). No reference is given, but presumably this is the R. Adams who wrote a section on the hip-joint in Todd's *Cyclopaedia of Anatomy and Physiology*. This was published by Longmans in 1839.

Probably Gruveilhier (1829) should have the credit for first distinguishing osteoarthritis, but the Viennese pathologist Weichselbaum (1872) played an outstanding part in developing an accurate concept of the disease.

In later years, a great deal of hard and painstaking work has been devoted to the chronic rheumatic diseases, and the two Ministry of Health reports, so often mentioned in this paper, and edited by Glover, have contributed very materially to a clarification of modern ideas.

This work was originally undertaken because of the difficulty experienced in setting up a standard of diagnosis for the treatment of the chronic rheumatic diseases.

The principal study published on this subject was the Ministry of Health report of 1924, in which a fairly large group of insurance practitioners undertook to record in the form of a questionnaire their findings during a set period in cases of chronic rheumatic disease. After studying this very useful report, it seemed likely that the findings of so many observers would vary to a degree that might interfere with its homogeneity.

It appeared that to estimate its real content, the whole field needed re-survey.

Lack of reliable data particularly accounts for the prevailing confusion in nomenclature and classification—and it will generally be agreed that clinical differentiation in commencement and course sometimes throw unexpected light.

The work is based on 1,000 cases falling into the group of the chronic rheumatic diseases. A good many, but not all, the cases were admitted to hospital for observation.

It would be of assistance if this paper could be read in conjunction with the Heberden Lecture of 1939 delivered by one of us (E.F.) as this would save a certain amount of duplication. Suitable references to this are given in the text.

In most branches of medicine the usual careful medical examination reveals all that is to be discovered by such a method, but in that branch which deals with medical diseases of the locomotor system special examination and search must be made for abnormalities which are not at all obvious, and of which the patient has no knowledge. This special examination has to be added to the routine medical examination, and does not at all replace it.

Although it may seem elementary to add details of examination to a paper which deals with such a specialised subject, yet past experience has shown that difficulties with and even error in diagnosis is often due to incomplete or inexperienced examination, and in courses of lectures and talks with practitioners great interest is usually shown in such details. A short résumé on this subject is, therefore, appended.

Method of examination

The following sequence is adopted, and it is most convenient and least tiring for the patient.

On arrival at the hospital, the patient's height and weight are taken, the temperature, pulse and respiration are recorded and a routine examination of the urine is made.

After the history has been taken, the patient undresses and lies supine on a couch, and the examination is conducted as follows:—

(a) *General condition.*

It is wise to try not only to assess the patient's general physical condition, but also to obtain some insight into his general mental make-up. In certain conditions, notably infective arthritis, there is a considerable psychological element, and it is as well to be aware of this.

(b) *Examination of the eye grounds, the reaction of the pupils, with a rough test of the cranial nerves.*

Many cases, particularly of osteoarthritis, are associated with arteriosclerosis and with hypertension. An examination of the eye-grounds, particularly after experience has been gained, will often give forewarning that such a complication may be present.

As pain is a prominent, if not an essential part, of most medical disorders of the locomotor system, the aim must always be to exclude all possible causes. The reaction of the pupils to light and accommodation, especially if taken in conjunction with the state of the knee jerks, is an observation which should always be recorded.

A rough test of the cranial nerves becomes so necessary because cases of muscular dystrophy, especially of the facio-scapulo-humeral type, may start with pain in the limbs. This is not, of course, by any means the only reason, but is given as an example of why this examination must be included.

(c) *Examination of the tongue, teeth and fauces and temporo-mandibular joint. Transillumination of the antra.*

It is not proposed at this point to discuss the very vexed question of focal sepsis. It is, however, necessary to say that, although cases due to focal sepsis may or may not be rare, it is a very poor service to a patient to miss it if it is present. When a genuine potent source of focal sepsis is present, its removal leads, as a rule, to permanent and complete cure. It is the greatest mistake

and very bad practice obviously to remove teeth, tonsils and other organs on the chance that they may be an important factor. It is, however, a greater mistake not to remove them when they are the *fons et origo* of the disorder.

(d) *Examination of the neck, cervical spine and the front of the chest. Estimation of the blood pressure. Range of movement in the shoulders.*

At this stage the neck is examined for glands in the triangles, as these may often be found in cases of infective arthritis, and the localisation and character of the glands must be determined in all cases. It is sometimes easier to palpate the paraspinal muscles in the cervical region while the patient is supine. Rotation of the head, which is seldom seriously interfered with, should be tested, and forward bending of the head and neck will often give a clue to disorder of the spine and its ligaments lower down, as the ligaments form a continuous band down to the sacrum. The position and size of the thyroid may be determined now, and it is a good plan to search, especially in elderly people, for an enlarged left supra-clavicular gland, a comparatively early sign in carcinoma of the stomach.

Fully circumabduct the shoulders, the arms and hands lying in a semicircle round the head. Palpate the brachial plexus for tenderness.

The front of the chest is examined by palpation, percussion and auscultation in the usual way, and the blood pressure is taken.

In addition to this always palpate the intercostal muscles and the costo-sternal joints, as these are the site of the unexplained pain in the chest in some cases.

(e) *Examination of the abdomen with the superficial reflexes.*

Especially palpate the gall-bladder and appendix regions, examining also for the size of the spleen.

(f) *Examination of the joints of the hands, elbows and radio-ulnar joints and their movement. Tenderness of nerves, reflexes and muscle strength.*

It is as well to adopt a method of notation for the small joints of the hands. Calling the thumb 1, the fingers are numbered on both sides, the little finger of course being 5. In addition, note the change present and which joint is affected.

For example:

R2 m.c.p. Sw. R3 m.p. D:
L1 c.m.c. P & T.

would mean the metacarpo-phalangeal joint of the right index finger is swollen, the mid phalangeal joint of the right middle finger is deformed, and the carpo-metacarpal joint of the left thumb is painful and tender. To the uninitiated this may seem slightly pedantic and unnecessary. This is not really so, for on seeing a patient after six months, say, it enables a complete check-up to be made quickly. Patrick's Goniometer (*B.M.J.*, August 19, 1944, p. 246) is invaluable for the measurement of movement at the radio-ulnar joints, and a small protractor can be used for the elbows and wrists.

With regard to reflexes, it is usual to test the supinator, biceps and triceps jerks and strength is usually tested by the grip, a dynamometer being used if desired, then flexion and extension of the wrists, elbows and shoulders.

Two nerves can be palpated easily, the musculo-spiral in its groove as it passes round the humerus and the ulnar nerve at the elbow.

- (g) The so-called *Lasegue* or *straight leg raising test* is performed, and the movements of the hip and knee-joints are observed. The feet are examined and the state of their ligaments and the mobility of the joints tested. Reflexes are tried. Tenderness of nerve and muscle is looked for.

The straight-leg raising test is a useful one for testing the structures at the back of the leg, thigh and low back. Care must be taken that the back lies quite flat on the couch, and that no tilting occurs. If a positive test is shown, its significance must not be over emphasised. It does mean that one or more of the structures mentioned above are at fault, but it is not true that it is a test for sciatica.

If, however, it is positive, it is wise to measure both thighs six inches above the upper border of the patella and the legs five inches below the lower border, as wasting of muscles is a common finding in some nerve lesions.

Any swelling of a joint must be measured and compared with the other side if it is sound.

Examination of the feet will, of course, note the presence of pes cavus or flat foot. Tenderness of the metatarso-phalangeal and mid-phalangeal joints should be recorded.

- Tenderness of nerves, especially the posterior tibial, should be looked for, and the usual reflexes, including the plantar reflex, tested. The usual way to test strength of muscles is to try flexion and extension at each joint, but the important movement in early lesions of the hip joint is abduction and adduction.
- (h) With the thighs held down the patient is asked to lean forward and touch his toes. This is rather a complicated test to evaluate accurately. In its simplest form it is an indication of the mobility of the lumbar spine, but before this can be accepted several other conditions must be fulfilled. In the first place, it must be ascertained by palpation that the hamstring muscles are not unduly short, and it must also be clear (see under g) that the hip joints have a full range of movement. A tender and inflamed sciatic nerve will interfere with the test, and so will myalgic conditions situated either in the back of the thigh or in the low back. In making the examination, therefore, it is as well simply to note that in trying to touch his toes lying the patient fell short by so many inches. At other stages any extraneous cause will be found.
- (j) Whilst leaning forward the back of the chest is percussed and auscultated, and the patient is then asked to reach up to the ceiling with his fingers.

A number of cases will be found complaining of pain in the arms or back who are suffering from pulmonary or pleural lesions. Bronchiectases, for instance, may give rise to pains anywhere in the body, and it is, therefore important to exclude such a complication. On more than one occasion a patient referred for osteoarthritis has been found to be suffering from carcinoma of the lung.

Failure to reach the fully vertical when reaching up to the ceiling with the fingers has two main and several subsidiary causes.

The two main ones are peri-arthritis of the shoulders (Dupley's Syndrome) and a fixed dorsal kyphosis. These two can be separated by putting the shoulders through a full range of movement and asking the patient to put his arms round his back. If the range of movement in the shoulders is full, then the dorsal spine should be carefully examined.

If neither of these tests reveal any abnormality a variety of lesions must be looked for, and it should be remembered that weakness may (occasionally) be the cause, and that a really stiff neck may be a factor.

- (k) With the hands down again the cervical and dorsal spines are tested for movement by lateral bending and torsion of the trunk. The back of the neck and its muscles are examined. The chest expansion is measured.

Testing the cervical spine for movement is a special manoeuvre. Standing on the right of the patient the left hand is placed round the neck at the back so that the cervical spine (so to speak) lies between the palm and the fingers. Holding the top of the head with the right hand, it is gently moved sideways in both directions. As the head moves the flexibility of the spine can be noted with the left hand. The important point is not to let the hand rotate; lateral bending is the essential movement. Rotation of the head is seldom interfered with, but should be tested next.

Chest expansion is naturally conditioned by many considerations, and it may be difficult to evaluate them all, but the point we are looking for is interference with the range of movement in the costo-vertebral joints. In certain conditions, such as ankylosing spondylitis, this is seriously interfered with.

- (l) The patient is then asked to turn on to his face: the way he does so is noted, hyper-extension of the hips is tried, and tender spots in any of the spinal and para-spinal muscles are looked for. The posterior sacral ligaments are palpated, as are also the posterior muscles of the buttock, thigh and calf. Tenderness is sought for in the more superficial nerves.

This is the stage at which extraneous causes for a positive straight leg raising test are usually found. Myalgic spots in the hamstrings and gastrocnemii are easily missed.

- (m) In certain case of unexplained pain in the arms and legs additional blood pressure readings are taken in the arms and legs and oscillometric readings taken.
- (n) *The patient is asked to stand up and touch his toes.*

The general posture is noted, deviations of the spine in any direction are observed, and the degree of lumbar lordosis.

The principal advantage of this sequence of examination seems to be that nothing is forgotten; also it involves the least amount of inconvenience to the patient and can be easily recorded.

In making a report to the Joint Tuberculosis Council on the method of recording tuberculosis

in the United States and Canada (Tubercle 1931) I gave it as my opinion that a printed form was not so good or so useful as a blank sheet on which the physician could enter what he thought of value. I had to reconsider this view when trying to decide on the best way of recording chronic rheumatism, and I think the reasons were that the physical signs of rheumatism are so diverse and so far-flung, even in a single case, that the whole body must be examined in order to arrive at a reasonable conclusion, whereas pulmonary tuberculosis seems to behave in a more sequential and orderly manner and to have better understood complications.

The patient is then sent for X-ray examination of the appropriate parts. If the sinuses transilluminate well, X-rays are comparatively seldom required, but it is sound policy to ask for X-rays of the teeth in most cases where many teeth are doubtful, and especially when dead teeth are present.

In addition, examinations and tests are done as the case demands, and the special department's co-operation is asked where needed.

The problem of classification

This section deals principally with the recording and classification of cases of chronic arthritis.

The Nomenclature Committee of the International League against Rheumatism are said to have gone through sixty different methods of nomenclature from different countries (Fox and van Breeman, 1934). Every conceivable basis is used: clinical, anatomical, pathological, radiological, and so on. There would be little to be gained by enumerating or quoting these classifications of rheumatism, but they were carefully studied when the present work was embarked upon. On the whole, it was thought that three of these systems should be more carefully considered.

The Ministry of Health classification (Glover, 1924) obviously needed study, for it represented the most careful work extant at that time.

Dr. Glover's Classification.

- A. *The acute rheumatic group*
 - (i) Acute rheumatism
 - (ii) Sub-acute rheumatism
- B. *The fibrositic group*
 - (i) Muscular rheumatism
 - (ii) Lumbago
 - (iii) Sciatica and brachial neuritis
- C. *The arthritic group*
 - (i) Rheumatoid arthritis
 - (ii) Osteoarthritis
 - (iii) Gout
 - (iv) Unclassified arthritis

At this stage it became necessary to decide what qualities a classification should possess to be of the greatest use.

First, it must be complete and embrace everything which could be met with in the course of the work, and nothing which was outside the field. Secondly, it must be helpful, that is to say, some definite advantage must accrue from its use. Lastly, it must not group together things which did not possess similar qualities. That was as far as I could go at that time, but subsequently other authors have defined what they need from a classification more completely and more clearly.

From the point of view of completeness, Glover's classification seemed to fall short. The skin lesions and the nerve lesions which could properly be called rheumatic were not included as there was no mention of erythema nodosum, panniculitis, or other forms of painful fat, or of interstitial neuritis except so far as sciatica and brachial neuritis secondary to fibrositis were concerned. Ankylosing spondylitis was considered so rare as to need special notification. On the other hand it was helpful, in that similar things were grouped together, but on the whole it did not suit my purpose for the reason mentioned.

I then turned to the classification first issued by the Nomenclature Sub-committee of the British Committee on Rheumatic Diseases, appointed by the Royal College of Physicians.

The Royal College of Physicians Classification.

Group I. Rheumatic fever, acute or sub-acute
(synonym: Acute rheumatism)

Group II. Acute gout

Group III. Chronic arthritis

(A) *Rheumatoid type* (atrophic, proliferative)

(a) Known aetiology

(b) Unknown aetiology

(B) *Osteoarthritic type* (hypertrophic, degenerative)

(a) Known aetiology

(b) Unknown aetiology

Group IV. Non-articular rheumatic affection.

TABLE II.

(amplifying Table I)

Group I. Rheumatic fever, acute or sub-acute
(synonym: Acute rheumatism)

Group II. Acute gout

Group III. Chronic arthritis

(A) *Rheumatoid type* (atrophic, proliferative)

(a) *Specific causation*, known aetiology

(i) Gonococcal arthritis

(ii) Tuberculous arthritis

(iii) Syphilitic arthritis

(iv) Arthritis following other specific infections, such as dysentery, scarlet fever, rheumatic fever.

(b) *Non-specific causation* in known aetiology

(i) *With known associated factors*

(A) Metastatic or focal arthritis including the so-called multiple infective arthritis

(B) Associated with disordered metabolism (e.g. Gout)

(C) Climacteric arthritis (villous type)

(ii) *With no known associated factors*

(A) Classical type of rheumatoid arthritis of women usually of child-bearing age

(B) Rheumatoid arthritis in children, including Still's disease

(The term "rheumatoid arthritis" when used should be confined to the above two conditions, all other forms being designated "rheumatoid type").

There was no doubt that so far as chronic arthritis was concerned, this was complete, but the great group of non-articular affections was left as a whole and not sub-divided. Seeing how large a part of the subject fell into this group, I thought this detracted from its value. When I came to consider whether it was helpful, I was struck by one or two outstanding disadvantages. I thought it unbalanced, as acute gout could hardly compare on an equal footing as a main group with chronic arthritis. The division of non-specific rheumatoid type arthritis into those "with known associated factors" and those without such factors did not seem to me particularly helpful, for it leads to one group which includes focal arthritis, gout, and climacteric arthritis, which really have comparatively few similarities.

Lastly, I turned to the classification of the International League, and here I was met with different difficulty, for the first group was sub-chronic arthritis, an arthritis, apparently, which followed rheumatic fever.

International Classification.

A. Articular

(i) Sub-chronic rheumatic arthritis (following on rheumatic fever)

(ii) Rheumatoid arthritis (arthritis variously described as focal, chronic infective

non-specific or multiple infective, of unknown origin atrophic, U.S.A.)

- (iii) Climacteric arthritis (endocrine, metabolic, hypo-glandular rheumatism, villous arthritis, cf. rheumatic gout, gout in women)
- (iv) Osteoarthritis (hypertrophic arthritis, arthritis senile, monarthritis)
- (v) Spondylitis (spondylosis rhizomelica, ankylosing spondylitis).

B. Non-articular

Fibrositis, myositis, cellulitis, panniculitis (lumbago, sciatica, perineuritis, adiposalgia, etc.).

The remainder of the classification appeared fairly straightforward, the only real attempt to classify being to divide the subject into two groups, articular and non-articular. From this point of view there seemed little positive advantage to be gained from its use.

On considering the title "sub-chronic arthritis" I tried to visualise cases of arthritis following rheumatic fever, and it became clear to me that when such cases ran a protracted course, they always fell into the group of rheumatoid, or infective, arthritis, that as far as I was concerned that was what I called them, and that if a special group was made for them, the classification would be unbalanced, for there would only be a few cases in any one man's experience.

As the subject is a very difficult one, it is helpful to quote Stone (1942), as his views coincide with mine and have been published. He says that an artificial classification is useful only for indexing and reference, but that a natural classification should so group things that they share a large number of common properties. To attain this end, a sound natural classification should conform to several rules. It should be exhaustive, and each class in the division should be defined, each division being grounded on one principle or basis. For example, in classifying doctors, they can be divided by the work they do—physicians, surgeons, obstetricians, etc.—or by nationality, personality, or success. But if these principles are mixed in the same division, we might find—physicians, surgeons, Welshmen, critics, rogues, and the Editor of the *Lancet*—which makes no sense. In the same way, as each sub-group is dealt with, only one principle should be used.

Further, one should not proceed from a wide to a narrow basis: for example, I cannot divide doctors into the Editor of the *Lancet* and those who are not the Editor of the *Lancet*, and this illustrates the general rule that the principle of division must be appropriate, that is to say, it

must be something from which as many things as possible can be inferred.

On these principles Stone tried to make a natural classification, using as his definition of rheumatism "painful disorders of the locomotor system whose aetiology is obscure."

He found he had to use as his first main divisions "diseases" of the locomotor system, and as his second "component syndromes," meaning by this, part of a concurrence of symptoms, so that myalgia, for instance, may be a bit of the pattern of a general toxic state, or a symptom of peripheral vascular disease. Very naturally these component syndromes were only subject to artificial classification.

At the outset I was not able to envisage the problem as clearly as this, but proceeding by trial and error and by a study of the existing classifications, I came to the conclusion that any real and useful classification of the chronic rheumatic diseases would be very complex, so that I gave up the idea of classification and simply recorded the cases as they appeared by the name of the syndrome to which they belonged. This is a well-tried, time-honoured method in clinical medicine. The disease index in its final form appeared as follows. (Abbreviations are also shown.)

Disease.	Abbreviation.
Infective arthritis	I.A.
Spondylitis ankylopoietica	S.A.
Osteoarthritis	OA.
Sub-group (A)—with normal weight and normal blood pressure	OA.A.
Sub-group (B)—with obesity and normal blood pressure	OA.B.
Sub-group (D)—with obesity and high blood pressure	OA.D.
Sub-group (N)—with normal weight and high blood pressure	OA.N.
Sub-group (H)—traumatic type and	} OA.H.
Sub-group (O)—occupational arthritis	
Sub-group (Spine)—osteoarthritis of the spine (includes hypertrophic spondylarthritis and hypertrophic spondylitis)	OA. Spine
Sub-group (Hips)—osteoarthritis of the hips	OA. Hips
(It is unfortunate that the letters of the sub-groups of osteoarthritis do not follow alphabetically: this is due to the fact that certain groups dealing with other variations were eventually cut out as having no significance.)	
Gout	G. I.
Unclassified (set out in detail later)	G. II.
Interstitial neuritis (including intercostal neuralgia, brachial neuralgia, sciatic neuralgia and "others")	Int. neur.
Myalgia	Malposn.
Malposition of the spine	Ost. chon.
Osteochondritis	Rh. F.
Rheumatic fever	S.A. Rh.
Sub-acute rheumatism	

Synovitis
Lesions of the shoulder-girdle
Non-rheumatic conditions

Syn.

Comment on the disease index

An explanation is necessary as to how the index appeared in this form.

As the matter was to be considered purely from the point of view of chronic rheumatism, it seemed right to exclude from the list associated, and even, possibly, aetiological factors, and simply to describe the pattern of the reaction which they caused. For example, if we take five cases of Paget's disease, we see they were entered as follows:—

- (1) Osteoarthritis (Group N)
- (2) Osteoarthritis (Group A)
- (3) Osteoarthritis (Group A)
- (4) Osteoarthritis of the hips
- (5) Sciatic neuralgia

So that on analysing, say, sciatic neuralgia, we find one case due to Paget's disease, and the next may be due to a prolapsed nucleus pulposus.

This method of recording was not used at the beginning, and a good deal of thought was given to the matter before it was finally adopted.

It seemed to me that in a piece of work devoted to chronic rheumatism, I should keep to the better-known rheumatic patterns. Patients were referred to the hospitals because they suffered from a syndrome which the doctor diagnosed as rheumatism, and indeed in many cases it was difficult to make a diagnosis with any certainty without an X-ray, so that I thought it right to keep the diagnosis to the pattern caused and then to enter the important and possibly aetiological factor after it. I have given the reverse angle of the same facts under the patterns caused—in the case of Paget's disease, psoriasis and diabetes. This will be discussed later.

I hope it will not be thought that I have unduly raised the importance of the rheumatic side, or failed to realise the significance of such conditions as I have mentioned.

Table I is a statement of the material on which this paper is based. Sex and age differences for the various types of rheumatism are fully dealt with in Part II.

Having taken the rather bold decision to keep a simple disease index, it remained to justify the assertion that all the cases of chronic non-specific arthritis could be given a name. In the opinion of a great many people the group of chronic non-specific arthritis is so complex and confusing, and the boundaries of diagnosis between the groups so blurred, that it is not possible to separate the groups clearly.

In view of the confused nomenclature in rheumatism already mentioned, a preliminary survey was made to estimate the possibilities, and it seemed likely that there were only in fact two types of bone and joint response to the great majority of insults and traumata. It seemed to matter little what they were called so long as they could be clearly defined, but the first appeared to be of an infective character, and so was called infective arthritis. The second was called osteoarthritis, and this term has the sanction of common usage.

It seemed probable that infective arthritis had many differences in individual cases in incidence, course and prognosis. It was tempting to make sub-divisions, or even main groups of these differences, *but it was felt that a substantial proportion of the difficulties in nomenclature* had been brought about in this way.

In case other groups should be found in the course of the work, an unclassified group was made so that this could be enlarged into a main group if it became necessary. This group must not be compared with Glover's (1924) group, which was *unclassifiable*. The unclassified group in this series contained cases which were insufficient in number to make groups of their own, and would have contained "unclassifiable" cases if they had been found in large numbers.

The sections which follow deal with the standards of diagnosis which were used for arriving at the different classes of chronic non-specific arthritis mentioned in the disease index and in Dr. Lewis Fanning's paper. It may be as well, however, first to consider the relationship of rheumatic fever (or acute rheumatism) and infective arthritis, so that, by deduction, we may be left with a stable residue of cases.

The relationship between rheumatic fever and infective arthritis

There can be no question that at first sight there seems to be little in common between a typical case of rheumatic fever in a child with its slowly developing carditis, and the classical picture of infective arthritis in an adult with its maximum incidence in joints, and so it would seem almost unreasonable to put forward the thesis that the difference is more apparent than real. Nevertheless there is some evidence of a link between the two conditions.

A diagnosis of rheumatic fever would be generally agreed in any patient who fell ill with pyrexia, arthritis of the bigger joints and some evidence of cardiac involvement. And more particularly 'sweating' was a marked feature. In the acute stage, clinical evidence of carditis is generally restricted to a mitral systolic or diastolic murmur.

TABLE I.
Diagnostic Distribution of 1,000 Cases of Rheumatism (in 100's)

Numbers of cases in 100's.	I.A.	S.A.	Types of Osteoarthritis.						Total cases of Osteoarthritis.	O.A. Hips.	Gout.	Fibrositis.	Osteochondritis.	S.A.R.	Rh. Fever.	Malposn. of spine.	O.A. Spine.	Sciatica.	Brachial neuritis.	Bell's palsy.	Periarthritis of shoulders.	Other forms of interstitial neuritis.	Unclassified.	
			A.	B.	D.	N.	H.	K.																
I-100	24	2	17	10	10	6	3	3	49	6	1	7	—	1	—	2	6	1	1	—	—	—	—	—
101-200	32	7	12	6	6	9	4	3.	40	3	2	5	1	—	—	8	—	—	—	—	—	—	2	2
201-300	22	6	8	6	6	2	1	1	24	7	8	7	1	3	1	3	9	3	4	—	—	—	2	2
301-400	17	1	5	7	8	5	3	—	28	5	6	21	1	3	1	—	2	6	2	4	—	—	3	3
401-500	27	3	8	2	7	—	2	—	19	4	3	19	—	1	5	1	5	4	1	4	—	—	4	4
501-600	20	3	15	6	4	5	4	—	34	2	5	11	—	2	1	5	4	4	1	2	1	—	5	5
601-700	25	5	7	3	4	1	2	1	18	3	4	10	1	4	—	4	—	10	2	1	5	2	6	6
701-800	30	5	7	6	4	1	—	—	18	3	1	13	—	2	2	1	1	10	1	—	6	1	7	7
801-900	27	10	1	4	2	3	—	1	11	5	5	15	—	1	—	—	2	6	1	7	5	—	8	8
901-1000	30	11	3	3	4	—	2	—	12	9	5	6	—	1	2	—	3	12	2	—	3	—	4	4
Totals	254	53	83	53	55	32	21	9	253	44	40	114	4	18	10	17	40	56	15	18	20	3	41	1000
Males ..	48	22	21	6	4	8	9	5	53	29	19	48	2	4	6	4	13	34	5	9	9	3	16	324
Females ..	206	31	62	47	51	24	12	4	200	15	21	66	2	14	4	13	27	22	10	9	11	—	25	676

For list abbreviations see Disease Index, page 11.

and, as is well known, this comes and goes, and may disappear altogether only to return many years later as fully fledged valvular disease. It is said by many authorities that the electrocardiogram at this stage shows alterations in the T wave in lead iv. Master and Jaffe (1933) found electrocardiographic changes indicative of myocardial damage in 63 consecutive cases of rheumatic fever, but not in one case of 46 cases of infective arthritis. This is an extreme finding, but is a helpful point in diagnostic difficulty.

This murmur on which the diagnosis may be said to depend only occurs in about half the cases of rheumatic fever, and, as stated already, is not continuously present. In the remainder of the cases the yardstick of clinical cardiac involvement cannot be applied for lack of evidence. The electrocardiographic evidence is unreliable, and although electrocardiographic tracings should be taken in every doubtful case, most cases of rheumatic fever will be found to show normal curves. Tachycardia and a systolic bruit may be present in any infectious disease.

It is always said that the bigger joints are involved in rheumatic fever, yet cases with involvement of the small finger-joints are seen occasionally and infective arthritis may often start in the knee-joint, or even in the hip-joint. (For analysis of joints involved, see later.)

Sweating occurs about equally in both conditions, and the pungent odour attached to it is a common feature. A curious point is that the odour may continue in infective arthritis long after the condition has become clinically quiescent.

Pericarditis is undoubtedly far more common in rheumatic fever, but it occurs occasionally in connection with infective arthritis. In the illustrative case-notes which follow, a case is included which demonstrates this (case 2).

It is generally said that the arthritis of rheumatic fever is of a fleeting nature, "flitting from joint to joint," each joint resolving as the process passes on, and it is really astonishing how quickly a red, swollen, exquisitely painful joint may clear up. The argument is that a case is not one of rheumatic fever if the joints fail to clear up, yet it is not an uncommon experience to find that the first hint that the case is one of infective arthritis is the failure of the joints to resolve, and they may even relapse after having apparently cleared up (see note on diagnosis under Classification).

Subcutaneous nodules are well known to occur in both conditions. In America, where the histology of these nodules has been extensively studied, opinion is divided: some think the nodules in the two conditions are identical, while others think not. McEwen (1933) says that rheumatic granulomata, as exemplified by subcutaneous

nodules, show large cells which stain characteristically with supravital stains, such as neutral red and Janus green, and differ from the cells of tuberculous and syphilitic lesions. Similar cells have been found by McEwen in nodules from cases of rheumatoid arthritis. They were found in 63 joint exudates, 8 pleural effusions, 4 pericardial effusions, from 33 cases of rheumatic fever and 27 of other diseases. In rheumatic fever, polymorphonuclear cells were increased, but decreased in proportion to the clasmotocytes as the joints recovered.

So far as a small personal experience goes, these nodules appear to be identical. Certainly their appearance is not the prerogative of rheumatic fever.

Prodromal symptoms, such as sore throat, are perhaps more common in rheumatic fever, but some of the worst cases of infective arthritis start with a streptococcal throat infection. Response to salicylates has always been looked upon as a characteristic of rheumatic fever, yet not all cases respond, and some cases of infective arthritis are markedly influenced by this method of treatment. Pleurisy is said to have a high incidence in rheumatic fever, and some authors say it occurs in 44 per cent of rheumatic children, but McEwen (v.s.) was not able to find the typical cells of rheumatic granulomata in pleura, pericardium, synovia.

Case 2 again illustrates that pleurisy may supervene in infective arthritis, and this is a less uncommon accompaniment than pericarditis. Erythema nodosum is little help in diagnosis. There seem now to be so many cases of unknown aetiology formerly the cases were thought to be either rheumatic or tuberculous, with a greater number occurring in tuberculosis—it certainly occurs in rheumatic fever, but quite a number occur in cases of infective arthritis.

Finally, the incidence of the two conditions is remarkably alike. They are both diseases of humid, temperate climates, and uncommon in tropical and sub-tropical zones; both apparently show their maximum incidence in Great Britain.

A good deal of the work on rheumatic fever has naturally been carried out in children, and it is generally agreed that the carditis is maximal at that time of life, and the arthritis maximal in adults. Salicylate therapy also shows its best results in children. Infective arthritis in children may take the form known as Still's disease, with enlargement of the spleen and lymphadenopathy, and rheumatic fever at that time of life tends to an acute form. In adults, however, both rheumatic fever and infective arthritis, with certain exceptions, tend to be less acute, and it seems possible that age itself may be a very important factor,

variation of the thought lying behind the "soil and the seed." Schlesinger's (1935) view is that rheumatic fever is becoming more common in adults, and less so in children.

The foregoing represents the chief clinical arguments in favour of common factors, and possibly a common aetiology in rheumatic fever and infective arthritis. From the laboratory angle even less difference may be found. In both conditions the erythrocyte sedimentation rate is usually and significantly raised, and a leucocytosis of a moderate character, with a shift to the left in the Arneeth count, is noted. Apart from these two findings, laboratory data are meagre. At the same time it will be better for the present to regard them as separate syndromes, for it is only the border-line cases which point the similarity, and the great majority are unlike, as indicated in the first paragraph. Researches in aetiology are indecisive, but whether a haemolytic streptococcus or a virus is to be incriminated, the manifestations must be very protean if they are to include both conditions. It will, nevertheless, be as well not to divorce them entirely in one's thoughts.

In this series there were 10 cases of rheumatic fever and 254 of infective arthritis.

Three Cases of Infective Arthritis

(To illustrate the point made in the text that it may very closely resemble rheumatic fever in some cases, and have no resemblance at all in others.)

Case I.

S.H. Male. Age 20. Soldier.

This man was passed fit into the Army in January, 1940, but gave a history of an attack of rheumatic fever in April 1940, when he was in hospital for six months, but passed out fit. Except for this, he had always been well, but his father had suffered from valvular disease of the heart.

On 11.2.41 he was admitted to hospital again, and said that six days previously he had quite suddenly noticed dyspnoea on exertion and pain and swelling in the ankles and left knee.

On examination, the temperature was 101.4°F ., pulse rate 96, and respirations 20. The heart was enlarged and showed pulsus bigeminus, due to extra-systoles. Blood pressure was 104/68. The electrocardiogram showed left ventricular preponderance and ventricular extra-systoles.

Two weeks later he developed swelling in the wrists. At this time the W.B.C. count was 8,400, with 54 per cent lymphocytes.

In a month's time the heart was apparently normal again, except for a systolic murmur. The knees and ankles were normal, but the wrists were still swollen and painful. The blood sedimentation rate, originally 98 mm.s at the hour, fell to 48 mm.s at this stage.

The man stayed in hospital for six months. At the end of that time the sedimentation rate, which had fallen to 9 mm.s, rose to 16 mm.s. The wrists and hands were deformed, swollen and painful, and

he thought the pain was coming in the feet. He was lost sight of on discharge.

This case illustrates how very alike rheumatic fever and infective arthritis may be.

Case II.

F.C. Female. Age 27. Shorthand-typist.

Came to hospital in October 1940, complaining of pain and swelling of the small joints of both hands. The wrists and elbows were also affected. She said she had always been well, but her brother had suffered from rheumatic fever.

On examination, there was swelling of the wrists as well as of the hands. She was pale and inclined to sweat easily. There was a systolic murmur at the apex, but no enlargement of the heart. Blood pressure was 118/76. There was no enlargement of the liver or spleen.

The sedimentation rate was 48 mm.s at the hour and the white cell count was 8,900 with a relative lymphocytosis. X-rays showed early change of an infective type in the wrists and hands.

She was admitted to hospital for treatment, but at the end of the first week she developed a right-sided pleural effusion which, on aspiration, showed a small number of polymorphonuclear cells, but was sterile on culture. At this time the temperature began to swing between 101.2 and 99°F .

A few days later she developed a pericardial rumble and became seriously ill. The W.B.C. count rose to 14,000, and the sedimentation was 60 mm.s.

With small fluctuations she remained in this condition for a month, when the heart began to settle down. The X-ray had previously shown great enlargement, which was confirmed clinically, but the apex beat began to come in. The lung base also began to resolve, and at the end of September 1941 (ten months after admission) she left hospital. The W.B.C. count was 8,000 and the sedimentation 22 mm.s. The systolic murmur was still present, and she still looked pale and ill, with a haemoglobin of 80.

I saw her twice more, but she never recovered completely, and the hands and wrists became more and more deformed. Eventually she died of congestive heart failure in December 1941.

No post-mortem was obtained.

This case is quoted because it illustrates the fact that cases which can reasonably be regarded as infective arthritis, may develop complications usually regarded as those of rheumatic fever.

Case III.

F.W. Female. Age 48. Housewife.

Came to London in January, 1942, complaining of pain and swelling in the hands and knees. Has had pains in various parts of the body, but no swelling of joints till two months previously. Her father had gout, but she had always been well except for recurrent dislocations of the right shoulder.

On examination she looked well, but the metacarpophalangeal and mid-phalangeal joints of both hands were swollen, as also were the wrist-joints. There was marked muscle wasting. The right shoulder was ankylosed. The knee-joints showed a bilateral effusion.

The sedimentation rate was 55 mm.s at one hour.

and the blood uric acid was 2.8 m.grms. per 100 c.c.s. The W.B.C. count was 12,400, with 65 per cent of polymorphs.

She was treated with glucose and insulin, and her weight rose from 7 st. 8 lb. to 8 st. 6 lb., when the treatment was discontinued. After this, gold treatment was instituted, and the condition gradually became quiescent.

She is still under treatment and at no time has the temperature or pulse rate been raised. The joints are resuming their normal functions, but muscle wasting and deformity remain.

This case illustrates how unlike rheumatic fever infective arthritis may be, and how difficult it becomes, on occasion, to think they have a common aetiology.

The Two Groups of Chronic Non-specific Arthritis

As mentioned already, the significance of the facts elicited in the course of the paper—as far as non-specific arthritis is concerned—will depend on the truth of the statement that only two groups of cases are found in practice.

It will be right, therefore, to state in detail the methods that were used in their separation and then to describe the results obtained. This matter has already been discussed in the Heberden Lecture of 1939, but not in great detail.

Throughout this paper only such differences as exceed twice their standard errors are regarded as significant, i.e. unlikely to have arisen by chance. Differences which exceed twice their standard error would probably occur by chance less than five times in a hundred trials.

The differentiation of the type—infective arthritis and osteoarthritis.

Sex, Age, and Occupation.

Infective arthritis appears to affect females far more than males. 30 per cent of the female patients seen belonged to this group, but only 15 per cent of the men, i.e. of the 1,000 cases, 48 were male cases of infective arthritis and 206 were female. This difference would be likely to arise by chance less than once in a thousand times.

The average age for the males with infective arthritis was 49, and for the females 48, and the difference between the mean age for all types and the mean age for infective arthritis was—1.48 years for males and—1.81 years for females, differences which are not significant. In Table II will be seen this series compared with Pemberton's and Monroe's, and it will be noticed that there is a considerable difference in the percentage age incidence, the patients in this series being as a whole much older, an average age of 47 as compared with 32 in Monroe's series. It is not possible to say why this is.

TABLE II.

Infective Arthritis—Percentage Age Incidence

Age.	Pemberton 536 cases.	Monroe 267 cases.	This series, 254 cases.
Under 10	2.4	3	nil
10—20	13.4	15	1.3
20—30	15.9	24	12.6
30—40	23.5	20	18.1
40—50	26.1	25	20.5
50—60	13.4	11	28.7
60—70	4.7	2	14.5
70—80	0.6	—	4.3
	Oldest 75 Av. age 37.4	Oldest 72 Av. age 32	Oldest 89 Av. age 47

$\chi^2 = 114.51$; $P = 0.000001$ shewing the three distributions to be dissimilar.

Analysis of occupation showed that in the male 7.9 per cent of outdoor workers and 20.8 per cent of indoor workers had infective arthritis. In the females, the figures were 31 per cent of women on light duty and 24 per cent of factory workers. It did not appear from this that hard work or exposed conditions favoured the disease. These differences were tested and found significant.

Osteoarthritis of the peripheral joints (except the hip) affected 12.03 per cent of males, and 27.22 per cent of females.

In this paper osteoarthritis has been divided into groups, the criteria of division being the presence or absence of obesity and of hypertension. Several more groups were originally added, but proved to have no significant value, and were subsequently allowed to fall back into the main data. The erythrocyte sedimentation rate was used as the additional criterion in these groups, and the information so obtained is discussed in the section on this subject.

Four main groups were left, and facts and figures from these groups are incorporated here. The Heberden Lecture was also largely concerned with this subject. The following groups, with their abbreviations, are shown in the disease index.

Group A.—Osteoarthritis with normal weight and normal blood pressure	O.A. (N)
Group B.—Osteoarthritis associated with obesity	O.A. (O)
Group D.—Osteoarthritis associated with obesity and high blood pressure	O.A. (D)
Group N.—Osteoarthritis associated with high blood pressure	O.A. (N)

The following tables (III and IV) show the differences of sex and age in these groups.

Table III shows that in group A there was no significant difference between the sexes as regards the proportion of patients attacked. Combining groups B, D and N, 18 per cent of the females, but only 5 per cent of the males, were included, a difference unlikely to be attributable to chance. Treating B, D and N separately, sex is seen to be of importance only in regard to the first two, and we therefore conclude that one respect in which group A differs from the others is that in A sex is not a factor, but in the others it is.

From Table IV it is seen that whether groups B,

D and N are treated individually or combined there is no real difference between the average ages of the males and females. In group A, however, the females are on the average nearly five years younger than the males. The average age of males in A is but little different from that of males in groups B, D and N taken together, but females in A are on the average $3.23 \pm 1.6^*$ years younger than the females in B, D and N groups. Thus the most that can be said of age as a differentiating factor is that females in group A are on the average three years younger than other osteo-

TABLE III.
Sex distribution of osteoarthritis.
Grouped as percentages of all types of rheumatism.

				Males	Females	Difference $\pm$ S.E.
Group A	..	..	..	6.48% (21)	9.17% (62)	2.69% $\pm$ 1.86
Group B	..	..	..	1.85% (6)	6.95% (47)	5.10% $\pm$ 1.5*
Group D	..	..	..	1.23% (4)	7.54% (51)	6.31% $\pm$ 1.5*
Group N	..	..	..	2.47% (8)	3.56% (24)	1.09% $\pm$ 1.2*
Groups B + D + N	..	..	..	5.56% (18)	18.05% (122)	12.49% $\pm$ 2.4*
All four groups	..	..	..	12.03% (39)	27.22% (184)	15.2% $\pm$ 2.8*
All types of Rheumatism	..	..	..	100.0% (324)	100.0% (676)	

(Figures in brackets denote the number of cases.)

TABLE IV.
Average age of osteoarthritis groups in years.

Sex	Group A	Group B	Group D	Group N	Groups B, D and N
Males	59.86 $\pm$ 1.7	54.17 $\pm$ 2.2	62.0 $\pm$ 3.8	62.0 $\pm$ 3.4	59.39 $\pm$ 1.90
Females	55.1 $\pm$ 1.4	55.36 $\pm$ 1.0	59.7 $\pm$ 1.1	61.2 $\pm$ 1.7	58.33 $\pm$ 0.72
Difference	4.8 $\pm$ 2.23*	1.19 $\pm$ 2.5	2.3 $\pm$ 4.0	0.8 $\pm$ 3.7	1.06 $\pm$ 2.0

TABLE V.
Differences between Mean Age of all Types combined and the Mean Age for Osteoarthritis.

Sex	Mean Age of all types	Group A	Group B	Group D	Group N	Groups B, D and N
Males	50.29 years	+ 9.57	+ 3.88	+ 11.71	+ 11.71	+ 9.10
Females	49.56 years	+ 5.54	+ 5.80	+ 10.15	+ 11.65	+ 8.77

TABLE VI.

Type of rheumatism	Males			Females		
	No. of cases	Obesity	Rate	No. of cases	Obesity	Rate
I.A.	48	0	0	206	30	14.6
O.A. (Groups A, B, D, N)	39	8	20.5	184	94	51.1
O.A. Spine	13	0	0	27	7	25.9
O.A. Hips	29	1	3.4	15	6	40.0
All other types	195	8	4.1	244	42	17.2

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arthritic patients. These facts are tabulated from a somewhat different angle in Table V.

A similar analysis comparing osteoarthritis—groups A–N combined—with infective arthritis shows that females were more heavily attacked than males by both types of rheumatism; in the case of osteoarthritis chiefly, as has been shown above, in groups B and D. There was no difference between the mean ages of the sexes in either type, but osteoarthritic patients, whether male or female, were on the average 9.9 ± 2.3 years older than patients with infective arthritis.

The occupation has been examined in detail by Dr. Lewis-Faning. He shows that taking osteoarthritis of all parts except hips, 20.4 per cent of all males were affected. 25.2 per cent of the outdoor as compared with 16.2 per cent of the indoor workers suffered, a difference of 9.0 ± 4.5 , which is barely significant. But 31.5 per cent of the heavy outdoor workers as compared with 16.2 per cent of *all other* types of occupation were affected, an excess of 15.3 ± 5.0 , which is statistically significant.

In the females the position was more difficult to assess, but if osteoarthritis of the hips is included (15 cases), 36.0 per cent of house and office workers as against 24.1 per cent of factory workers were affected, a difference of 12.8 ± 6.6 , which is just within the realm of chance.

Physical Type of Patient

(a) Infective arthritis.

Obesity was not a common finding. There were no obese males, and 14.6 per cent of obese females.

On the whole, the patients showed one common feature—a rather pale, anxious expression, with cold clammy hands, and the great majority tended to be under weight. These features are not, of course, peculiar to infective arthritis, as they appear in many other forms of rheumatism, but they seldom appear in osteoarthritis.

(b) Osteoarthritis.

Obesity was a common finding. The figures are set out in Table VI. In osteoarthritis (Groups A, B, D and N) 20.5 per cent of males and 51.1 per cent of females were obese. This includes all types of osteoarthritis except those affecting the spine and hips—these are kept separate unless specially mentioned. These figures compare with obesity rates in infective arthritis of 0 per cent for males and 14.6 per cent for females.

It is difficult to find figures to compare as no large survey has been made, but Spriggs (1936), said that 6.2 per cent of admissions to Ruthin Castle

were treated for obesity. Hunter (1936) said that of 912,677 new patients treated at the London Hospital between 1927 and 1936, 26 per cent were referred to the dietetic department for treatment. It seems probable that the proportion for the population as a whole lies somewhere between the two.

Proportion of cases of Infective Arthritis and Osteoarthritis in which Obesity was present.

The question of obesity has been fully dealt with in the Heberden Lecture. Apart from obesity patients with osteoarthritis do not present any very typical physical characteristics, although in the case of women they tend to be of a sub-thyroid and myxoedematous type. Nevertheless, true myxoedema is not often seen (there were only three cases in this series), and therapeutic tests with thyroid extract do not present any very startling results.

The question of the association of osteoarthritis with the menopause is of some interest, and figures are given in the section dealing with this and other important associated syndromes. Many authors postulate a particular form of arthritis associated with the menopause. On occasion I have seen joints at operation showing synovia covered with what appeared to be fatty villous overgrowth, and it is true that this does not always appear to be associated with a generalised obesity. Mention will be made later of painful fat, and it is possible that this fatty articular overgrowth may be painful. Apart from these scattered and rather dubious observations, one cannot be at all sure that there is a particular form of menopausal arthritis.

Joints initially involved in infective arthritis.

These have been analysed. For the males, 56.2 per cent of cases showed initial involvement of the small joints, and for the females, 64.6 per cent. The clinical impression was that the figures would be even higher. As more is understood, however, of this subject, it becomes evident that infective arthritis does affect the larger joints in a fair proportion of cases.

Joints initially involved in osteoarthritis.

For the males, 72.7 per cent showed initial involvement of medium or large joints, and for the females, 73.1 per cent showed the same feature.

These figures, therefore, show the most significant difference in the two conditions, and are a point in favour of the Ministry of Health's method (1924) of separating the conditions clinically, but are not a complete justification.